MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2015/2016

PCM0035 – GENERAL CHEMISTRY

(All sections / Groups)

17 OCTOBER 2015
9.00 a.m – 11.00 a.m
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of 4 pages only excluding the cover page.
2. Attempt **ALL** questions. Distribution of the marks for each question is given.
3. Please write all your answers in the Answer booklet provided.

QUESTION 1 [20 MARKS]

(a) (i) Rank the following electrons, shown in **Table 1**, in the order of increasing energy (from lowest to highest):

	n	l	m_l	m_s
(i)	5	1	0	½
(ii)	3	2	2	-½
(iii)	4	3	1	½
(iv)	4	0	0	½

Table 1 [2 marks]

(ii) Given three elements: Sodium, Potassium and Silicon. Rank these three elements in order of decreasing atomic size (from highest to lowest). [1.5 marks]

(b) Manganese is a chemical element with atomic number 25.
(i) Draw the orbital diagram for manganese without using a noble gas core. [1.5 marks]
(ii) State the number of unpaired electron does manganese has. [0.5 marks]

(c) Given three compounds: Na_2O, Al_2O_3 and SO_3.
(i) Which compound can be classified as an amphoteric oxide? [1 mark]
(ii) Write a balanced chemical reaction equation for the reaction of SO_3 with water. [2 marks]

(d) Specify the group of the periodic table (i.e. group 1A) in which each of the following elements is found:
(i) $[Ne]3s^23p^5$ [1 mark]
(ii) $[Ar]4s^23d^{10}$ [1 mark]

(e) Draw the Lewis structure for $BFCl_2$ and determine whether this compound obey the octet rule. If no, identify the octet rule exception for it. [2.5 marks]

(f) Name the shape (molecular geometry) and give the AB_mE_n classification for the following compounds:
(i) $BeBr_2$ [2 marks]
(ii) PF_3 [2 marks]

Continued...

(g) For the following compound in **Figure 1**:

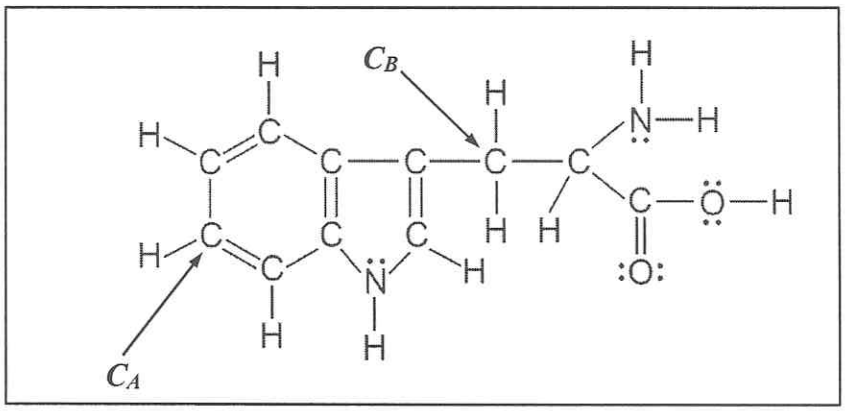


Figure 1

(i) Predict the correct hybridization for the carbon atom, C_A and C_B, indicated in the molecule. [2 marks]

(ii) Determine the number of sigma (σ) bonds in the molecule. [1 mark]

QUESTION 2 [20 MARKS]

(a) State the difference between amorphous solid and a crystal solid on the macroscopic level and molecular levels? Give an example of each solid. [3 marks]

(b) Name the phase change in the following event:

(i) Dew appears on a lawn in the morning. [0.5 mark]

(ii) Bronze being molten down in an industry. [0.5 mark]

(c) Identify the relationship between intermolecular forces and surface tension. [1 mark]

(d) The normal melting point and boiling point of water at 1 atm are 0 °C and 100 °C respectively. Predict what would happen to the melting and boiling points if both melting and boiling were carried out at around 0.5 atm.
[Triple point of water: 0.01 °C; 0.06 atm] [2 marks]

(e) Consider the following reaction between nitrogen dioxide and carbon monoxide.

$$NO_2(g) + CO(g) \longrightarrow NO(g) + CO_2(g)$$

The initial rate of the reaction was measured at different reactants' concentrations as in **Table 2** below:

$[NO_2]$	[CO]	Initial rate M/s
0.1	0.10	0.0021
0.2	0.10	0.0082
0.2	0.20	0.0083
0.4	0.10	0.033

Table 2

Continued...

From the data, determine each of the following:
(i) The rate law for the reaction [4 marks]
(ii) The rate constant, k for the reaction [2 marks]

(f) At 40 °C, the second-order reaction $N_2O_5\,(g) \rightarrow 2NO_2\,(g) + \frac{1}{2}O_2\,(g)$ is 50% complete after 3.0 hours when the initial concentration of N_2O_5 is 3.75 mol/L. How long will it take for the reaction to be 90% complete? [4 marks]

(g) Referring to the reaction below:

$$2H_2S\,(g) + O_2\,(g) \rightleftharpoons 2S\,(g) + 2H_2O\,(g)$$

(i) Predict what will happen to the concentration of H_2O if some amount of O_2 is added to the system. [1 mark]
(ii) What is likely to happen if the concentration of H_2S is reduced? [1 mark]
(iii) Predict and explain the effect on the equilibrium system if a catalyst is added. [1 mark]

QUESTION 3 [20 MARKS]

a) A voltaic cell uses a spontaneous reaction to generate electrical energy. Define anode and cathode in a voltaic cell. [1 mark]

b) A voltaic cell with a copper bar and a zinc bar are immersed in $CuSO_4$ solution and $ZnSO_4$ solution respectively as depicted in **Figure 2**.

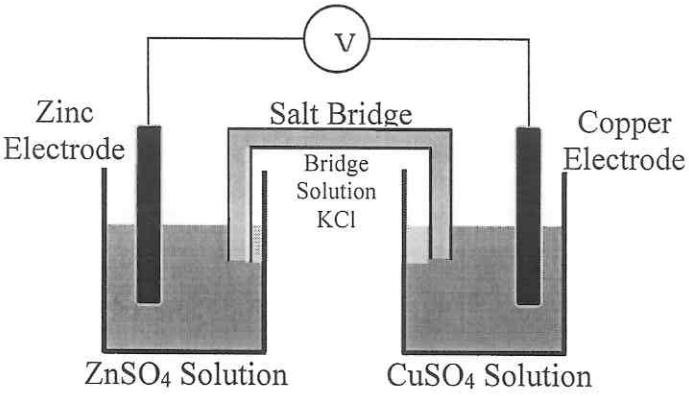


Figure 2

(i) Write the half-reactions and the net reaction for the electrolysis. [2.5 marks]
(ii) Explain the function of salt bridge and state the requirement of the selection for the solution in the bridge. [1 mark]

Continued...

c) The half-reactions of electrolysis of molten barium chloride, $BaCl_2$ is given as below:

Anode: $2Cl^-(aq) \rightarrow Cl_2(g) + 2e^-$
Cathode: $Ba^{2+}(aq) + 2e^- \rightarrow Ba(s)$

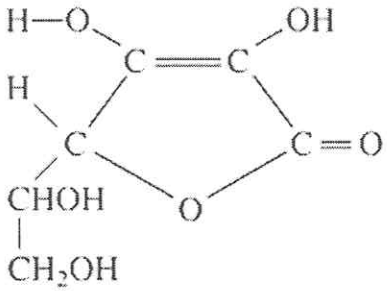
If a certain amount of current x ampere is being supplied for 1 hour in order to produce 1.1g of Ba metal, calculate the required amount of current x.
[Atomic Mass: Ba=137.3 and Faraday constant = 96500C/mol e^-] [3 marks]

d) One kilogram of copper and one kilogram of magnesium are produced by electrolysis process. By considering only the electricity cost of the electrolysis process, which metal has cheaper production cost. Justify your answer.
[Atomic Mass: Mg = 24.3 and Cu = 63.5] [2.5 marks]

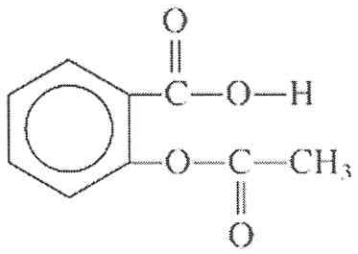
e) Acetic acid (CH_3COOH) is a weak acid that can be ionized reversibly with water.
(i) Write down the complete reaction equation of acetic acid in water. [2 marks]
(ii) According to the answer found on (i), identify the acid-base conjugate pairs of the reaction. [1 mark]

f) Briefly explain the statement of ***'across a period, non metal hydride acid strengths increases'*** that describes the trends of acid strength across the periodic table. [2 marks]

g) The structures of acetylsalicylic and ascorbic acid are shown in **Figure 3**. Identify the acid that would have weaker acid strength. Justify your answer. [2 marks]



Ascorbic (Ka = 8.0 x 10^{-5})



Acetylsalicylic (Ka = 3.0 x 10^{-4})

Figure 3

h) Given that the *Ka* of formic acid is 1.7 x 10^{-4}. Find the pH of 0.50 *M* formic acid (HCOOH) solution. [3 marks]

End of Paper